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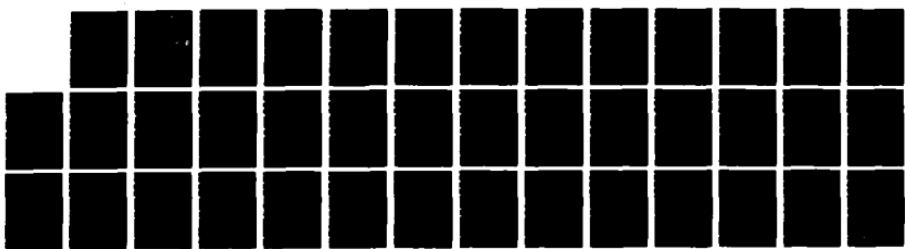
EDITING MASTER OCEANOGRAPHIC OBSERVATION DATA SET 4(U)
COMPASS SYSTEMS INC SAN DIEGO CALIF R A BAUER ET AL
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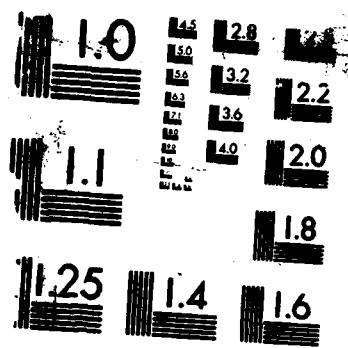
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FINAL REPORT

EDITING MASTER OCEANOGRAPHIC OBSERVATION

DATA SET4

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Naval Ocean Research and Development Activity
NSTL, Mississippi 39529-5004

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The ocean subsurface temperature and salinity profiles collected at Fleet Numerical Oceanography Center from their archive of radio message reports was edited to correct call signs, remove duplicates and flag errors. Surface only measurements were separated from the profile reports and paired temperature-salinity profiles were recombined. The entire National Oceanographic Data Center file of hydrocast data was reconverted to eliminate old problems and to take advantage of NODC's edit efforts.		
The mechanical bathythermograph reports that lacked temperature corrections		

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and had the necessary fields were corrected. The update tapes are intended for use in updating MOODS4, which contained over 4.6 million oceanographic reports. Key words, say under transmission, Oceanographic Data editing MFOODS (Master Oceanographic Observation Data Sets), Both by the means of data, User Surface, Data processing.

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EDITING MOODS4

INTRODUCTION

This project, funded by the Naval Ocean Research and Development Activity (NORDA) in July 1987, allowed Compass Systems, Inc. (CSI) to begin editing the data in the Master Oceanographic Observation Data Set (MOODS). The present version of MOODS, MOODS4, was produced by the third update of MOODS that CSI completed at Fleet Numerical Oceanography Center (FNOC), Monterey, CA in September 1985. The MOODS4 tapes contain 4.6 million reports including the National Oceanographic Data Center (NODC) physical oceanographic profile data holdings, all of the real time subsurface reports that have been received at FNOC and other profile data obtained from a variety of sources, including research institutions and foreign navies. The reports in MOODS had been passed through a primitive set of quality tests that had set flags but had not removed observations. All previous efforts to create and update MOODS were directed toward aggregating the data from multiple sources with knowledge that some but not all of the data in some of the newer sets duplicated reports already included. This project started the process of removing these redundant data and took advantage of the improvements made in processing real time data.

After the MOODS4 tapes were completed at FNOC the Naval Oceanographic Office (NAVOCEANO) assumed responsibility for maintaining MOODS. The results of this editing contract will not appear in the MOODS file until NAVOCEANO produces a MOODS5 set.

Beginning in June 1985 CSI was funded by the U.S. Tropical Ocean Global Atmosphere (TOGA) project office of NOAA (1) to access the real time data and to

produce monthly quality controlled extracts of these data. The TOGA project resulted in the installation of the Zenith Z-100 based microcomputer system labelled the Quality Improvement Profile System (QUIPS) that has been used at FNOC since April 1986 to edit both unclassified and classified reports. Starting in January 1986 CSI began editing the unclassified reports extracted from the FNOC message files to remove non-exact duplicates, correct call signs and recombine temperature and salinity profiles. This mini MOODS update procedure split the FNOC MOODS S10 file archive tape into files of classified and unclassified MOODS data and created a monthly update to the master MOODS tapes at FNOC. The level of non-real time quality control (QC) increased throughout 1986, as the National Ocean Service (NCS) and the FNOC-resident NODC employee assumed responsibility for producing weekly sets of edited subsurface reports in September, ending CSI's funding for maintaining the TOGA-related monthly MOODS files. In October 1986 NAVOVCEANO and FNOC chose not to continue using the CSI-developed procedures for maintaining the MOODS update stack tapes in the FNOC operational center or to utilize the edited version of the unclassified data for operational extracts (2).

The minutes of the MOODS workshop held at NORDA 17-18 October 1985 (3) contain a list of recommendations including the creation of an edited version of MOODS, which was estimated would cost between \$100,000 and \$150,000. This \$75,000 project was aimed at producing edited subsets of the MOODS4 data that would: 1) correct known conversion errors and remove redundant data in the hydrocast source sets; 2) calibrate bathythermograph reports so that they could be combined with other data in statistical tests; and 3) make an initial edit pass of the message data, applying the TOGA-developed correction techniques.

The description of these three edit tasks from the CSI proposal (4) follows:

Task 1. Replace NODC Hydrocast Records.

1. Obtain and convert the entire NODC Universal Station II (USD2) file.
2. Extract, resort into platform order and rerun the speed test on the following MOODS source codes to identify redundant data sets: 17, 18, 19, 21, 22, 26, 27 and 30. (See extract of TABLE 1 from the MOODS Functional Description (5) included before References.)
3. Create sorted speed record files during the conversion and check the above sets for any additional redundancies.
4. Eliminate from MOODS the old source code 4 and 15 sets and any others that are redundant, including recycling the appropriate backup and source tapes in the MOODS archive.

Task 2. Calibrate NODC Northern Hemisphere Mechanical Bathythermograph Data.

1. Extract the source code 3 mechanical bathythermograph (MBT) data from MOODS4 and then extract data in the northern hemisphere cruises in the NODC processed MBT reference number range that have reference temperatures but not temperature correction (TCS) values.
2. Resort these data by reference number, instrument code and consecutive number. Calculate a TCS for each instrument and plot the data by instrument for review.
3. Review the calculated TCS values greater than .5°C using the listing and plots and prepare a correction file.
4. Apply the corrections and submit the combined set of northern and previously calculated southern hemisphere corrections to NODC.

Task 3. Message Data Edit.

1. Extract message data from the MOODS4 tapes into a separate file and divide the extracted data into 3 subsets: surface only reports, hydrocast component reports and temperature only reports.
2. Test data failing temperature range tests and attempt to correct, assuming they were converted from Centigrade rather than Fahrenheit, using both the surface and 120M temperature climatologies. Attempt to correct reports with excessive depths by using 120M temperatures and by assuming that the depths are in feet rather than 10's of feet. Check for increasing depths and set a profile flag for reports failing the IGOSS spike test (6).
3. Resort the data into cruise order and revise the ship call signs using the new updates to the FNOC ship code file.
4. Using software developed for TOGA combine the hydrocast component reports into a single MOODS record, removing nonexact duplicates in the process.
5. Using TOGA software, eliminate nonexact duplicates which are at the same time and position but have different numbers of levels.
6. Merge the subsets and reset the speed flags using the improved list of collective call signs.

DISCUSSION

The tasks selected were those which CSI believed would provide the greatest benefit for the available funds and were tied directly to NORDA's immediate needs. Task 1 reprocessed and eliminated duplicates within the hydrocast source

files, which provide all of the matched temperature and salinity values for the calculation of sound velocity profiles and a few directly measured sound velocities. Task 3 combined the real time temperature and salinity profiles so that they would also be accessible for sound velocity calculations. Tasks 2 and 3 eliminated or flagged reports that create major biases in statistics calculated from the MOODS data by calibrating the MBT reports and performing a whole series of correction, flagging and duplicate elimination operations on the real time data. Each of the task elements is discussed below in sequence.

Task 1.

NODC, having undergone a number of computer hardware changeovers, has finally arrived at a stable configuration on the UNIVAC computer at Asheville. While CSI had obtained and incorporated the latest updates from NCDC for each of the 3 update cycles, the data tapes had been in different formats from different NODC computer systems. There was evidence that some North Pacific data had been lost and there were zero salinity values in the file that were not marked as missing values. Additionally, NODC had made a significant effort to remove duplicate cruises and correct data in this file. Rather than duplicate their editing effort, CSI arranged with NODC to obtain a new copy of the entire file at no cost to the Navy. The MOODS conversion routine was modified to insure that all converted salinity values were within a reasonable range, and the results of the conversion and MOODS error flag settings summarized by NODC cruise number were sent back to NODC.

The forward processing direction dictated by the past MOODS updates produced a set of edit flags in each source set. The conversion and processing sequences were intended to flag duplicate reports of lesser quality; however, there had

never been time to produce a listing that showed the number of interfile duplicates flagged in each source, and within each source the number of flags of each type set within each cruise. This second element of Task 1 modified the existing codes in the speed test sequence to summarize the flags set. The last element in the task was to eliminate and recycle the old hydrocast source tapes in the MOODS archive at FNOC, thereby releasing approximately 140 tapes.

Task 2.

The second task corrected a long-standing problem with the NODC MBT file. When NODC digitized MBT observations they did not calculate and apply instrument corrections; consequently, even though the reference temperature may have been offset from the profile surface temperature by a significant constant temperature difference, the profile temperatures were never adjusted. This was a common problem with the MBT's and was caused by the bending of the arm holding the stylus in the instrument at any time after the calibration grid was made. NODC considered the MBT data to be only a relative measurement, but in practice most researchers who use MBT data treat them as if they were calibrated. When CSI used MBT data to produce monthly temperature atlases for the northern hemisphere the offsets were handled by computing average difference means (7), i.e., creating an average profile by adding the average difference between standard levels to the surface mean value. While this produced usable inputs to a labor-intensive edit process, it is not recommended for purely statistical analyses since it still relies on the validity of the surface mean known to contain biased values. In the Southern Hemisphere Atlas project CSI attempted to use the MBT data without calibration and discovered it was impossible because the sample was so small that the biases were obvious. CSI subsequently calculated

corrections for all MBT cruise sets in the southern hemisphere and applied these corrections to the MBT data in MOODS. The NODC MBT file is now part of their UBT set. When NODC converted their MBT file to UBT format, the essential instrument code needed to separate the reports by instrument was discarded, so that NCDC could no longer correct the MBT reports. As CSI had already completed the corrections for the southern hemisphere, the software to carry out this task was available and tested on the FNOC computers. This was a labor-intensive, one-time operation, but it had to be done if the MBT reports were to continue to be included in the samples on which variability statistics are calculated. Since the MBT's represent over a third of the unique observations in MOODS and represent the older data, CSI believed MBT data were important.

To complete this task the MBT source file was extracted from the MOODS4 file and divided into two parts. The reports in the cruise number ranges not assigned to the Scripps Institution of Oceanography (SIO) were separated from the other reports and passed through the correction sequence if the cruise had reference temperatures and had observations without previous temperature corrections. These cruises were reviewed for consistency and trends by looking at the surface temperature, the calculated difference from the reference temperature and the Bauer-Robinson climatology values at the surface and 120 meters. Reports that showed offsets indicating the slide was not properly registered in the instrument mount were adjusted with special corrections or deleted. The corrections were applied to the MOODS file. A special correction file was then prepared, providing the cruise number, observation number, time, position and TCS correction, so NODC could correct its UBT file.

Task 3.

The real time data had never been edited and were pieced together from many undocumented tapes found in the FNOC tape locker. Most of the early reports were at one time on cards that sometimes got out of order as they were handled, resulting in garbled reports. Based on CSI's study of these data, many were unique reports not in the processed NODC files, making it potentially a very valuable file. However, its enormous size--over one million reports--and its poor quality made it the most difficult to handle. Additionally, the edit flag tests which were developed primarily for cruise order processing the KBT data were poorly suited to this data set. Specifically the MOCDs default 30 knot speed test was applied to reports made by aircraft and to reports made on different platforms but identified by a collective platform code. The intrafile nonexact duplicate flag test does not distinguish between a hydrocast and BT temperature profile and looks only at the number of levels rather than the maximum depth, so nonexact duplicate flags were set on reports that were unique. Nonexact duplicate reports are those that occur at the same time and location but have different profile data.

To edit the real time file, it was divided into three segments: one containing surface only reports, which are usually made by aircraft; the second containing hydrocast component reports and the third containing only temperature profile measurements. The hydrocast reports normally are divided into two separate reports at FNOC: one containing temperatures and the second containing salinities. Both parameters are originally reported at the same depth levels, but the number of levels may be truncated in either component and intermediate levels are lost when the data are converted to MOCDs if they can be recomputed

using linear interpolation. Using codes developed for processing these data for TOGA, the components were recombined into a single report containing both temperature and salinity with the missing data values included if the levels reported did not match. All of the real time profiles were then edited using codes that were developed for TOGA.

CHRONOLOGY

The original project schedule was specified so that the results from this contract effort would feed into the installation of MOODS on the NAVOCEANO computer during the summer of 1987. The project, however, had two links to the TOGA grant effort: CSI's staff was working on both projects simultaneously and the planned use of the TOGA-developed editing techniques on the historical MOODS real time data source set in Task 3. After the initial start on the edit tasks, which included extracting the MBT and radio message source sets from MOODS4 and making sure that the MASTER program could read and convert test tapes of USD2 tapes produced by NODC on the Asheville computers, most of CSI's efforts were devoted to the TOGA programs. Between July and September the TOGA effort consumed all of CSI's resources as the weekly near-real time message edit sequence replaced the monthly TOGA processing and the access through NODDS replaced the monthly mini MOODS update cycle. CSI developed the mini MOODS update cycle and ran it monthly from February through September 1987, maintaining an updated version of the MOODS classified data tape and an unclassified MOODS stack tape in the FNOC operational center. After the first runs of the mini MOODS update in February 1987 resulted in a recall of the downgraded data, the downgrading feature was inhibited, but the mini MOODS update cycle still served to separate

the classified and unclassified data, set MOODS QC flags and maintain current MOODS tapes in the FNOC center. When the OAG near-real time edit cycle began functioning in September, unclassified data had to be extracted weekly rather than monthly. FNOC, having decided not to use the near real-time edited data operationally, also elected not to continue the mini MOODS update procedure, so the operational MOODS tapes have reverted to the MOODS4 set.

By December the NODDS (QUIPS) process was running smoothly, and time was available to extract the different source sets from MOODS to see how much redundancy there was in the different hydrocast and XBT data sets. Table 1 summarizes the results and shows that none of the source sets were completely redundant. In December CSI was also able to run some TCS plots using the program developed to correct the MBT reports for our Southern Hemisphere Atlas. After working with these listings for several weeks, it became clear that excessive time was required to look up values to determine if reference temperatures were bad and that a better job could be done in less time if the Bauer-Robinson Numerical Atlas values were shown on the listing. Consequently, the edit correction efforts were suspended until the program could be modified.

In February 1987 Mr. Bauer visited NAVOCEANO and saw that their implementation schedule was slipping. Also, on that trip CSI's TOGA efforts were given an increased priority when the decision was made to update the QUIPS capacity at the National Meteorological Center (NMC) to use the microVAX workstation for real time QC of all marine data with a watch staff that had to be hired in FY 1987. This addition to the TOGA grant effort consumed the major portion of Mr. Bauer's time throughout the remainder of the project and resulted in the request for extension of the contract performance period to 1 November 1987.

TABLE 1. SOURCE OF MOOSA4 ERROR FLAGS FOR SELECTED SOURCE CODES

	LAND	DEPTH	SPEED	SURF	INTRA	INTER				
4	686752	700	11062	9567	5893	3629	0	SD2		
5	125834	249	185	1570	0	1215	418	SPOT FNOCXB1		
7	1715					24		STD		
8	132558	221	22	11130	0	1286	977	BRITISH XBT/MET		
9	75776	94	0	520	0	440	342	AMBI WHOI MET		
11	56702	25	2	397	0	394	30	JAPAN MBP/XBT		
12	91	0	0	2	0	1	1	LAMONT XBT		
14	799	0	0	2	0	4	0	ARGEN/JAPAN		
15	15153	24	159	475	0	63	50	SD1-SAFR/JAP		
16	35347	19	675	0	0	1030	24	FRENCH (NEW)		
17	18817	3	1	0	0	236	231	KOREAN HYDRO		
18	200	0	0	0	0	0	0	JAPAN PUB DATA		
19	89	0	0	1	0	0	0	FOSTER STD		
20	8900	139	4	1	0	151	58	OLD FRENCH		
21	1858	0	0	0	0	3	0	NORWAY		
22	8286						2	KRJUN		
26	289						5	MHYD		
27	2212						226	CSU		
31	20337	153	0	502	0	57	4	0	0	JFIS
33	5099	0	10	60	0	12	0	0	0	NOOM
34	94802	35	150	8479	0	1883	1222	3195	0	SIO

The final shipment of the last 10 tapes containing the NODC USD2 file was received in mid February and the full set of 19 tapes was converted to MOODS during March and early April. For the conversion of the USD2 file, the MOODLGO program at FNOC was modified to check for zero salinity and to change the variable header to include water color and transparency (MOODLGO update 40). MOODS4 quality tests were run on the set, and the MGEO order tape for source code 4 was delivered to NORDA on 24 April 1987. This tape contained 686,752 reports.

The conversion run listing showing decode errors and zero salinity locations was given to NCDC on 4 June 1987. Additionally, the final tape was resorted into cruise order and the speed set printout was modified in MOODLGO to show how many MOODS4 flags were set in each cruise. NCDC has used this listing to extract the cruises with decode and duplicate errors and is now working to review other cruises with high error flag counts.

Additional runs were made to determine if any of the MOODS4 source sets could be eliminated based on the contents of the USD2 update. The results showed that none could be, but NCDC requested and was given copies of the Japanese hydrocast tape. CSI also provided copies of the extracted reports from the FNOC CALMA XBT digitization, which have now been converted to UBT format by NCDC and are being screened for inclusion in the NCDC UBT file.

On 1 May 1987 CSI shipped NORDA the unclassified message data edited as part of the TOGA project for 1985 and 1986. These tapes, which were also sent to NCDC, are the "best" global versions of the FNOC unclassified message data, although the NCDC TOGA report file is better for the Pacific TOGA area. The 1985 data combined reports extracted from MOODS4 and the data extracted from the FNOC MOODS S10 archive classified tape without any downgrading. In comparison

with the 1986 tape, the 1985 data set is only partially edited. Some non exact duplicates were removed, salinities were fixed and the call signs were passed though the garble table. The 1986 tape shows the results of increasing levels of non-real time editing. The data before September were only edited on the monthly schedule with no graphic interactions. Starting in September 1987, call signs and profiles have been edited with the aid of time series plots, geographic plots and the near-real time QUIPS station. These efforts are described in CSI's TOGA report (8).

After the delivery of these two tapes, CSI began editing the historical pre-1985 data. The major portion of the effort was devoted to modification of the call sign using the concept of the garble table. Hundreds of runs were made to identify safe call sign translations for inclusion in the garble table. The MOODS4 message edit processing section of this report provides a detailed documentation of this major effort.

In July 1987 the complete set of MBT plots and listings was created with the additional Bauer-Robinson Numerical Atlas differences at 0 and 120 meters. The hand editing of these data was done entirely by Mrs. Margaret Robinson, who had headed the Scripps Institution of Oceanography Bathymeterograph Processing Section while the instrument was in active use. The details of this process are documented in the MBT Correction Process section of this report.

The two real time update tapes, the pre-1985 unclassified data and the MOODS4 classified data, were shipped to NORDA by FNOC on 20 October 1987. The final MBT update was shipped to NORDA by CSI on 29 October 1987.

The following sections on the MBT correction process and the real time edit process contain detailed descriptions of how the corrections were accomplished,

and are included primarily as an aid if these efforts are ever continued in the future. The casual reader may wish to skip these sections.

MBT CORRECTION PROCESSING

The ICS correction applied to the MBT data is a statistic correction based on the assumption that the reference temperature is absolute and the profile measured by the MBT is relative. The correction is computed separately for each instrument used on a cruise and on occasion may be computed for subsets of those observations when a shift in calibration is observed. The procedure is simple but necessary if the temperature measurement made with an MBT is to be averaged with XBT's or hydrocast data or is to be used in determining a distribution of temperatures for an area.

The processing sequence is outlined in Table 2. To calculate the ICS correction all MBT reports with instrument codes, sources 3 and 9, were extracted from the MOCD\$4 tapes--a total of 1,039,030 observations. This file was then divided by program MBTSPLT into two files. The first contained 347,667 reports that were from Australia, had no instrument codes, or were in the NODC cruise number block 10,000 to 16,000, which had been processed at SIO and had already had TCS corrections applied. The second file had 691,363 reports, which were then sorted into cruise, instrument and time order. Program MBTDIVD split this second file into a file of 131,516 correctable reports and a file of 559,847 reports that had already been corrected or were uncorrectable. The correctable reports were listed and plotted with a modified version of the CHKTCS program originally created to edit southern hemisphere data before a numerical atlas was available.

TABLE 2
TCS SEQUENCE

JOB STEP	JOB PROGRAM	INPUT FILE	OUTPUT FILE	FUNCTION
1.	MOODEXT	MOODS4	69152	Extract sources 3 and 9
2.	MBTSPLT	69152	69720 MBTNOCOR	First separation of MBT reports with blank Inst Code, 10,000- 16,000 cruise numbers and Aus- tralian MBT's
3.	MBTSORT	69270	MBT(69723) 69724	Sort by Inst, NODC cruise and time
4.	CHKTCS	MBT	TSCARDn	Compute and plot TCS correc- tions
5.	CONSECSRT	MBT	MBTCON	Sort by Inst, NODC cruise, NODC consecutive number
6.	MODFTCS	MBTCON	MBTTCSCOR	Apply TCS corrections
7.	CONSRT	MBTTCSCOR	MBTSRT	Sort by NODC cruise and con- secutive number
8.	MBTDEL	MBTSRT	MBTNEW	Delete reports
9.	GECRSRQUAL SRIMOOD	MBTNEW	MBTGEO SRT	MGEO sort
10.	QUAL MOODLGO	MBTGEO SRT	MBTNEWGEO	MOODS MGEO flag set
11.	MBTMERGE SRIMOOD	MBTNEWGEO 69720 69724	32487	MGEO merge
12.	DUPSTOT MOODLGO	32487	18151	Eliminate dups and reset MGEO MOODS flags
13.	TOTALMBT	18151		Check final tape

Note: All jobs on CLIB file UMBTPGM, ID=RB

The modification added a comparison of the MBT temperatures and the Bauer-Robinson Numerical Atlas at the surface and 120 meters. Additionally, the program was changed to plot all reports rather than just those where the computed TCS value exceeded .5°C. The addition of the atlas values greatly speeded the subjective evaluation and provided additional clues to identify out-of-position reports and cases where the MBT glass slide was improperly registered in the instrument or when it had been photographed.

The subjective edit process took approximately six man weeks spread over a period of three months. It resulted in a file of TCS corrections that could be applied to all reports made by the instrument in the cruise, a file of special corrections, a file of deletes and a list of cruises that NODC needs to check for positions.

To apply the corrections, the correctable file had to be resorted by NCDC cruise number, instrument number and consecutive number. The 96,863 corrections were applied by program MCDFTCS and then the file was resorted into cruise number, consecutive number order to make the 387 deletes.

The edited file of 131,129 reports was resequenced and passed through the standard MGEO sequence edit flag setting procedure using the NOODIO procedure. This procedure eliminated 7 exact duplicates, found 19 interfile duplicates, set 1112 land flags (mainly over the Great Lakes) and 588 SST flags (with a large number being in cruises made out of Norfolk, where the positions were suspected in the TCS listing.) The correct file was merged with the two uncorrected or uncorrectable report files generated by the MBTSPLT and MBTDIVD programs to produce a new MGEO order file. Because of evidence that there were some exact duplicates in the original MOODS4 file caused by the incomplete sort

specification used in early MOODS updates, the entire file was subjected to a resetting of the NGEO MOODS flags using procedure MOODIO. This process eliminated an additional 27 reports and identified 4,743 non exact duplicates probably introduced by the Australian MBT updates. There were 1,038,609 reports on the MOODS update tape and 2,866 have land flags set (again, primarily in the Great Lakes, which are blocked out of the land sea table) and 5,584 SST flags. There were only 4 reports with maximum depth errors. The list and tape of corrections and deletes was sent to NODC so they could update their CBT file.

MOODS4 MESSAGE EDIT PROCESSING

The edit process for the MOODS source 2 was divided into a sequence of jobs, each composed of a series of procedures and program steps. Standardized program, procedure and intermediate data file naming conventions were established to provide well-defined interfaces between steps and jobs and to facilitate restarts when they were necessary. Each developed entity was tested using several data subsets. Each job was described as a job set as each was applied to the several subsets of the data defined during the project.

Job set 1 consisted of a series of one-time individual jobs calling procedures, MOODIO and SRTMOOD, which were developed under previous efforts as generic MOODS extract and sort/merge interfaces to form the major seven unclassified process subsets--the 1985 subset, the 1986 subset, the five arbitrary, approximately equal divisions of pre-1985 data--and the eighth, classified MOODS4 subset. Division into subsets allowed processing entirely on disk. A complete 1985 subset was formed by combining the MOODS4 1985 subset with the 1985 subset of the TOGA-funded monthly mini MOODS update set. A complete 1986 subset

was extracted when the cumulative weekly QUIPS corrected MOODS set from the TOGA grant funded MOODS-to-NODDS system was partitioned to start 1987.

Job set 2 consisted of the series of steps summarized in Table 3 using the procedure names developed during this effort.

- 1) SEL. Partitioned each subset into a salinity subset and a temperature subset.
- 2) SSL. Processed each salinity subset to:
 - a) Correct surface salinity tens position of ppt based on valid salinity reference from MOODS variable header or from the Bauer-Robinson Numerical Atlas climatological value;
 - B) Correct subsurface tens transition. (Conversion from FNOC 4D format had dubbed the value 3 into the tens position for every level, since the format excluded tens position; and
 - C) Reidentify missing levels appropriately.
- 3) SW. Processed each result of 2) to remove reference salinity from the variable header.
- 4) TTL. Processed each temperature subset to reidentify missing levels.
- 5) SZZ. Processed each combined result of 3) and 4) to delete reports with entirely missing levels,
- 6) SMM. Processed each result of 5) to remove missing levels.

Job set 3 is a modified version of the NODDS/QUIPS NJOB3 module. Table 4 provides a summary of the sequential job set 3 process steps. Job set 3 applied the ship code garble cross reference table to each cruise (CRUZ) sequenced subset using program RECLAS to correct ship codes. The development of the garble cross reference table was the major effort in Task 3. The ship call sign

TABLE 3
MOODS4 MESSAGE FILE EDIT PROCESS JOB SET 2

JOB STEP	PROCEDURE PROGRAM	INITIAL FILE	RESULT FILE	FUNCTION
1	PPAR,[N],SEL MPARSEL	CLASS[N]	CLSSS[N] CLTSS[N]	Partition the file between temperature/salinity subsets
2	PPAR,[N],SSL MPARSSL	CLASS[N]	CLSSS[N]S	Correct tens position of salinity/old missing levels
3	PPAR,[N],SVV MPARSVV	CLSSS[N]S	CLSSS[N]V	Remove reference salinity from variable header
4	SRIMODD SORIMRG	CLSSS[N]V CLTSS[N]	CLASS[N]V	Merge files together
5	PPAR,[N],TTL MPARTTL	CLASS[N]V	CLASS[N]T	Reidentify old missing Temperature levels
6	PPAR,[N],SZZ MPARSZZ	CLASS[N]T	CLASS[N]Z	Remove missing profile Reports
7	PPAR,[N],SMM MPARSMW	CLASS[N]Z	CLASS[N]C	Remove missing levels

Note: [N] = 0(CLASS),1,2,3,4,5(pre-1985),85,86

TABLE 4
MOODS4 MESSAGE FILE EDIT PROCESS JOB SET 3

JOB STEP	PROCEDURE PROGRAM	INPUT FILE	RESULT FILE	FUNCTION
1	SRTMOOD	CLASS[N]C	TEMP[N],CY=A	Cruise sequence(CRUZ)
2	MOODIO	TEMP[N],CY=A	-	Summary print
3	MRECLAS SORIMRG XREFSHP SORTMRG XREFDUP RECLAS	TEMP[N]C SHIPREF(FNOC) XREF TABLE GARBLE/UXANO/AS XREF TABLE TEMP[N],CY=A	XREF TABLE TEMP[N],CY=B	Garble table rename process
4	MOODIO	TEMP[N],CY=B	-	Summary print
5	MOODIO MOODEXT	TEMP[N],CY=B	TEMP[N],CY=C	Standard weekly garble correction via modify
6	SRTMOOD	TEMP[N],CY=C	TEMP[N],CY=D	TIM/POS/CC/SHIP(MGEC) sequence
7	MSGSPPL	TEMP[N],CY=D	MSGAC[N] TEMP[N]2,CY=A TEMP[N]3,CY=A	Partition file into surface ARTST,CTEM/BATHY(JJXX)/ TESAC(KXXX)
8	SRTMOOD	MSGAC[N]	TEMP[N],CY=A	Count reports
9	SRTMOOD	TEMP[N]2,CY=A	TEMP[N]2,CY=B	TIM/POS(MGEO) sequence
10	MOODUPS	TEMP[N]2,CY=B	MSGHSVS[N] MSGHSVD(N)	Identify and separate duplicate report sets from singles
12	MOODIO	MSGHSVD[N]	-	Print duplicate report sets
13	SRTMOOD	TEMP[N]3,CY=A	TEMP[N]3,CY=B	TIM/PCS(MGEO) sequence
14	MOODUPS	TEMP[N]3,CY=B	MSGBDS[N] MSGBDD[N]	Identify and separate duplicate report sets from singles
15	MOODIO	MSGBDD[N]	-	Print duplicate report sets

field in the historical message set contains various processing anomalies including garbles caused by radio transmission noise that resulted in extra, lost and perverted characters; FNOC 4D format changes, e.g., area of interest code had been prefixed to the ship call sign on 11 May 1970; truncated ship name substitution when the call sign was absent or beyond recovery; substitution of numeric pseudo-ship code and subsequent partial loss of the pseudo-ship cross reference table, etc.

The garble table was developed using a special version of program MSGSPL that provided rough tables of proposed name reassignment to known valid ship call signs. Each entry in the rough tables was created when there were multiple reports in the file with exactly the same time and positions. These usually resulted from delayed or non exact duplicate receipts of these observations on AUTCDIN or reentry of a report at FNOC more than 72 hours after it was taken. The rough table derived from each major subset was processed independently to remove duplicate entries while retaining a count of the number of duplicate entries as a measure of quality. Objective tools were developed to aid in the largely subjective process of inter- and intra-table comparison to further qualify entries for a final garble table. An objective editor called EDIT, a non-standard CDC product, was embedded in a CCL procedure interface to facilitate comparisons. Typically a particular letter combination forming part of a valid ship name would have on the order of 50 cross entries, many of which would also be crosses to other ship codes or names. As a result, the final table included upwards of 30 alternate codes for a single platform. Through a substantial effort, the final garble cross-reference augment table corrected about ten percent of the ships in the original MOODS4 file set that had previously been

unidentified. After applying the garble table call sign changes, the subsets were each resequenced by time/position/country/shipcode (MGEC) for input to program MSGSPL. MSGSPL partitioned each subset into surface MSGAC (ARTST/CITEM), BATHY (JJXX), and TESAC (KKXX) type subsets. Processing ended at this point for all MSGAC subsets. These MSGAC reports are on the delivery tapes as file 2. The other subsets were separately resequenced by time/position (MGEO) for each major subset and individually passed to program MOODUPS, which identified duplicate pairs (SETS) and partitioned each subset into a singles subset and a multiples subset.

In the weekly MOODS correction cycle each multiples subset requires subjective deletion to eliminate duplicate pairings prior to the NJOB4 step, but the sheer volume of duplicative sets in this historical process precluded such subjective processes. Job Set 3A, Table 5, was developed and applied to the five pre-1985 subsets and the classified subset. It should be noted that this process was not developed until after the 1985 and 1986 subsets were shipped. Job Set 3A replaced the usual weekly QUIPS subjective process of eliminating non exact duplicates with an objective process based on experience with the historical weekly subjective decisions. Table 6 presents the simplistic interpretation of certain MOODS field element values used in this objective decision-making process.

Job Set 4, Table 7, is a modified version of the NJOB4 module. Job Set 4 recombined the TESAC (KKXX) pieces using program MOODKKX. Then program MOODLGO was used to set the MOODS quality flags in the CRUZ and MGEO sequences, completing the Job Set 4 process for the 1985 and 1986 subsets. For other subsets the process included recombining each resultant subset with its corresponding

TABLE 5
MOODS4 MESSAGE FILE EDIT PROCESS JOB SET 3A

JOB STEP	PROCEDURE PROGRAM	INPUT FILE	RESULT FILE	FUNCTION
1	PPARSDP,[N],[TYPE] MSG[TYPE][N] MPARSDP		MSG[TYPE][N]C MSG[TYPE][N]D	Perform subjective omit process to avoid duplicates in Job Set 4

Notes: Job Set 3A was not applied to 1985 and 1986 sets.

N=0,1,2,3,4,5

TYPE=HSVD,BDD

TABLE 6

MOODS FIELDS USED TO ELIMINATE DUPLICATES

Tests assume sorted, paired comparison of MOODS reports of the same type.

NUMBER OF LEVELS	In the historical message file the shorter profile is presumed to be the result of objective truncation caused by a problem, and the longer trace is then the result of subjective operator correction.
DEPTH FLAG	Deselect report with depth flag set.
DEPTH PARAM CCDE	Deselect more precise depth. The bulk of the historical file is in tens of feet. One report at a precision of feet does not add significance. Not valid for current real time file.
PARAM 2 FLAG	Deselect report with flag set.
BITS PER LEVEL (DEPTH)	A measure of roughness. The roughest profile is de-selected, avoiding the large depth jumps associated with objective truncation process.
BITS PER LEVEL (2ND PARAM)	A measure of roughness. The roughest profile is de-selected tending to avoid the profile with spike, except that zero bits per level are de-selected.
FPB (VARIABLE HEADER)	De-select report with more reference values. Assumes that lesser came in later as a correction.

TABLE 7
MOODS4 MESSAGE FILE EDIT PROCESS JOB SET 4

JOB STEP	PROCEDURE PROGRAM	INPUT FILE	RESULT FILE	FUNCTION
1	SRTMOOD	MSGHSVD[N]C	TEMPA	Resequence MGEO
2	MOODKKX	TEMPA	TEMPB,TEMPC	Recombine TESAC pieces
3	SRTMOOD SORTMRG	TEMPB,TEMPC MSGBDD[N]C MSGBDS[N]	TEMPD	Resequence ship/time(CRUZ)
4	MOODIO	TEMPD	TEMPE	MOODS cruise quality process
5	SRTMOOD	TEMPE	TEMPF	Resequence time/position (MGEO)
6	MOODIO	TEMPF	TEMPG	MOODS geo quality process
7	SRTMOOD MSGBDD[N]D MSGHSVD[N]D	TEMPG	MOODS[N]FINAL	Time/position (MGEO) sequence

Note: Each Job 4 Initiated via procedure NJOB4ST/UTOGA or UJOB/AS

subset of duplicate reports removed in the Job Set 3A. Since the JOB3A process was necessarily objective, the deleted observations were retained so that future subjective comparisons might be made.

Job Set 4A, Table 8, applied the newly developed program MPARDEP to remove those observations exhibiting non-increasing depth characteristics. Those observations were combined to form file 3 of the shipment. All observations exhibiting such characteristics predated program S10MOOD and are related to the 4D format archive.

Job Set 4B, Table 9, combined the subsets to form the pre-1985 unclassified and classified tapes.

MOODS EDITING STATUS

In the description of tasks there are elements that were not done by this project because of the direction NAVOCEANO took in implementing MOODS. In Task 1 no comparisons were made between source set 30 and the NODC files because NAVOCEANO had decided to include its version of these data in its retrieval system and deleted them from MOODS. As it turned out, in the source code 15 data, comprised of the NODC SD1 file, South African and Japanese data included in MOODS from hydrocast card images, the redundant NODC SD1 portion of the file had already been deleted as part of the MOODS3 update. As described previously, the Japanese part has been sent to NCDC. NCDC has arranged to obtain a complete update from South Africa, which it will use rather than the older MOODS input file to update its USD2 file. In Task 2 all MBT's for which CSI could calculate corrections were reviewed, not just those with corrections greater than .5° C, and the corrections were applied without regard to hemisphere. This resulted in

TABLE 8
MOODS4 MESSAGE FILE EDIT PROCESS JOB SET 4A

JOB STEP	PROCEDURE PROGRAM	INPUT FILE	RESULT FILE	FUNCTION
1	PPARDEP MPARDEP	MOODS[N]FINAL	MOODS[N]FINALGOOD MOODS[N]FINALBAD	Ship/time sequence(CRUZ)
2	MOODIO	MOODS[N]FINALBAD	-	Reports print

TABLE 9
MOODS4 MESSAGE FILE EDIT PROCESS JOB SET 4B

JOB STEP	PROCEDURE PROGRAM	INPUT FILE	RESULT FILE	FUNCTION
1	SRTMOCD SCRIMRG	MSGAC[N],N=1,85 MSGAC0 MAGTAPE1	MAGTAPE1 MAGTAPEA MSG16ACBTE	Combine sets to tape
2	COPYBF	MAGTAPE2	MSG0ACBTE	Form BT=E set on tape
3	SRTMOOD SORTMRG	MOODS[N]FINALBAD,N=1,5 MOODS0FINALBAD MAGTAPE2	MAGTAPE2 MAGTAPEB MOODS15FINALBADBTE	Combine sets to tape
4	COPYBF	MAGTAPEB	MOODS0FINALBADBTE	Form BT=E set on disk
5	SRTMOOD SORTMRG	MOODS[N]FINALGOOD,N=1,5 MOODS0FINALGOOD MOODS16ACBTE	MAGTAPE3(FILE1) MAGTAPEC(FILE1) MAGTAPE3(FILE2)	Combine sets to tape
6	COPYBF	MOODS0ACBTE MOODS15FINALBADBTE	MAGTAPEC(FILE2) MAGTAPE3(FILE3)	Move BT=E set to tape
7	COPYBF	MOODS0FINALBADBTE MAGTAPE3	MAGTAPEC(FILE3) MAGTAPE4	Move BT=E set to tape
8	COPYBF(3)	MAGTAPEC	MAGTAPED	Prepare shipment

additional corrections to some of the Southern Hemisphere reports originally corrected for our Southern Hemisphere Atlas.

In Task 3 the surface only reports were separated out of the MOODS file into their own file, and CSI recommends maintaining them separately or with the surface marine reports.

The edits proposed in item 2 of Task 3 were not performed because the tests have evolved into a portion of the near-real time edit sequence that requires interactive decision making. Since this project lacked the resources to select which of the non exact duplicates should be saved, the non exacts were merged back into the file after MOODUPS identified them in steps 10 and 14, as shown in Table 4, with a setting of the non exact duplicate flag based on the criterion in JOB 3A. The subjective decisions required will be simple and easy to make once QUIPS2 is operational, so CSI elected not to use this project's resources on the problem. The reports with depths repeated or out of order were separated out of the MOODS main file but were sent as file 3 on the update tapes. These reports likewise will be easy to edit on QUIPS2, so CSI minimized its efforts on them for this project.

The IGOSS tests were implemented in the near-real time edit sequence in the step NODDS/QUIPS NJOB5. This step was not applied to the historical data set because it involved extensive subjective work. Again, QUIPS2 may make it possible to review the historical traces in cruise sets but that is beyond the present capability.

In this project CSI did not modify any of the MOODS4 QC tests, so that these reports can be merged with the other source sets and produce a consistent QC level throughout. Additionally, since NAVOCEANO and NORDA are improving on

these QC tests, CSI believed that continued effort at FNOC in parallel was not a productive use of the project's limited resources.

CSI has made changes to the MOODLGO and MCCDEXT programs during this project which have been submitted to the FNOC source level libraries. The only significant change to these programs that is not documented in the CSI-prepared FNOC documentation are the changes to the variable header description in the MOODS Data Description. That 2 page change was part of this project's progress report #2 and is attached to this report before the references. The second change was to prevent MOODLGO and MCCDEXT from setting the intrafile duplicate flag. This duplicate process is now done NODDS/QUIPS NJOBL through NJCB6.

CONCLUSIONS

This project marked the first time that NODC directly participated in the MOODS update process. The results showed there are data in MOODS that should be in the NCDC files and an initial effort was made to transfer those data. NODC is using the MOODS conversion results to edit the USD2 file and is adapting some of the MOODS QC testing techniques. The result is that the USD2 file, although the newest now in MOODS, should be updated again in its entirety within a few years.

Assuming NCDC applies the MBT TCS corrections, the same applies to the MBT file since NCDC changed the ship names to NCDC ship codes during the conversion to UBT and has eliminated duplicates in this file. NODC has been given the XBT source code 5 file and will be inserting it in UBT. Again, when that process is complete the entire XBT file should be updated.

This participation by NODC is welcome and commendable, and CSI hopes that it

will continue as it is clear that this is only the start of what should have been happening all along.

In September 1986 with the mini MOODS update operating, CSI reached a long term design goal of MOODS: to keep an up-to-date classified and unclassified MOODS stack tape in the FNOC operational center. This achievement was not appreciated by either FNOC nor NAVOCEANO, and it may be several years before that event is repeated. In the near term neither the Navy's requirements nor those of the civilian community will be adequately provided with complete sets of quality controlled data.

TABLE I. Fixed Header (Continued)

<u>NUMBER</u>	<u>NAME</u>	<u>SIMPLE VARIABLE NAME</u>	<u>BIT LENGTH</u>	<u>SKIP BITS</u>	<u>RANGE</u>	<u>MISSING DATA</u>	<u>BIAIS</u>	<u>SCALE</u>
17	Source File	ISF	6	91	1-63	R	-	-

CODE NO.
 MI00 1=100 ft data from Scripps Institution of Oceanography and 30M data from Compass Systems, Inc.
 FOUR,4DBN 2=Fleet Numerical Oceanography Center 4D message data
 MBT 3=NODC XB1 in file 106 format
 SDII 4=NODC hydrocast and STD data in Station Data II format
 SPOT 5=NODC XB1 in SPOT format
 EDII 6=NODC EDII format XB1 data
 STD 7=NODC STD data in file 61 format
 BRIT 8-British MBT and XB1 data
 HCIC 9=NODC XB1 data in card format and Australian modified format
 XB1 10=NODC XB1 data in file 17 format
 JAPA,JAPB 11-Japanese MB1-XB1 data
 LAWD 12-Lamont XB1 data
 DISPLCO 13-NMFS SWFC XB1 format (with salinity)
 ARGE 14-Argentine and Japanese inflection point data profiles punched by Compass Systems, Inc.
 SDI 15=NODC hydrocast and STD data in hydrocast card format SDI
 FREN 16=new French and Noumea data
 KORE 17-Korean depth/temperature/salinity data
 JCRD 18-Japanese standard level JARE published data punched by Compass Systems, Inc.
 FORS 19-STD data from Foster at Scripps Institution of Oceanography
 FRQ 20-old French MB1 Mediterranean data
 NORW 21-Norwegian depth/temperature/salinity data
 KARV 22=NODC STD data in file 22 format
 EMER 23-Emory STD tape
 AMBT 24=University of Hawaii XB1s and AX1s
 UBT 25=NODC XB1, XB1 and WHOI data in XB1 format
 HYD 26=Monterey Bay data-McLain HYDALL
 DSUN 27=Oregon State Newport line data hydrocast and CID
 NXBT 28=NAVOCEANO XB1 data
 NCID 29=NAVOCEANO CID data
 NSID 30=NAVOCEANO STD data
 JFIS 31=Japanese fish survey data
 CALF 32=California Fish and Game BI data
 NOUM 33=Noumea XB1s 6/79 through 12/81
 S10 34=S10 composite 79+ data set
 NXB2 35=NAVOCEANO XB1/AXB1 data FEB format
 NDEF 36=German DEF format data

14 DEVS/SET 4
 17 RECORD TYPE 2
 18 FORMAT 3 CHAR CODES US SET NAME USD2
 BINARY FORMAT NO REFERENCE NCDC
 UNIVAC STATION DATA II L
 OCTOBER 3, 1980

		INPUT	SKIP	#BITS/	BIAS/	
		BYTE	BITS	CHAR	SKIP	NOTES
Record Length	1	Computed				
Lat Hemisphere	-2	1/27		1		1PN TO 0, 1RS TO 1
Long Hemisphere	-3	1/33		1		1PE TO 0, 1RW TO 1
Lat Degree	4	1/28		2		
Long Degree	5	1/34		3		
Month	6	1/41		2		
Year	7	1/43		2		
Day	8	1/45		2		
Hour	9	1/47		2		HOURS
Min	10	1/49		1		TENTH OF HOURS CONVERTED TO MIN
Lat Min	11	1/30		2		
Long Min	12	1/37		2		
Class Code	13	=0				
Class Level	14	1/70		1		
No. of Parameters	15	C				
No. of Level's	16	C				
Source File	17	=4				
Quality Flag	18	=0				
Thinning Flag	19	=0				
Ident Type	20	=0				
Variable Header	21	Computed				
Set Code Identifier	22	=1RX				
Call/Ship/Set	23	1/50		6		
Country Code	-24	1/3		2		
No of Observ. Depth	25	2/62		3		
No of Standrd Depths	26	2/65		2		
Parameters		IDATA			IPR	IOF
Depth	31	3+1	1	5	2	1
Temp	32	3+8	2	5	1	SET BY 43
Salt	33	3+15	3	5	1	" " 44
Sound Velocity	34	3+/27	4	5	1	" " 45 Zero out NODDS4
Oxygen	35	3+ 32	5	4	1	" " 46
Depth Quality	36	3+ 6	6	1	1	(SEE NOTE ON NEXT PAGE)
Temp Quality	37	3+ 14	7	1	1	
Salt Quality	38	3+ 21	8	1	0	
SigP Quality	39	3+ 26	9	1	0	
Oxy Quality	40	3+33	10	1	69	0
(CONTINUED ON NEXT PAGE)						

TABLE 3.35 DATA BREAKOUT (CONTINUED)

SET NAME USD2
VARIABLE HEADER CODE

VAR.						
	HEAD.	INPUT	SKIP	#BITS/	BIAS/	NOTES
	BITS	BYTE	BITS	CHAR	SKIP	
NODC Set Number	51	16	1/5	5		
NODC Consec Number	52	11	1/10	4		
Orig Consec No. Flag	53	2				
Field Present Bits	54	11				
Inst Type	55	2	1/15		19 = 1 = NANSEN	2=STD
Qual	56	4	1/69	1		
Lat .1 Min	57	4	1/32	1		
Long .1 Min	58	4	1/39	1		
SV Max	59	7	1/61	3	100 METER UNITS	
Water Color	60	7	1/107	2	Pouelle scale	
Water Trans	61	7	1/109	2	Meters	
Bottom Depth	62	7	1/56	3	100 Meter units	
Spacing	63	7	1/85	2		
Duration	64	6	1/65	3		
Direction	-65	2	1/68	1	54	0=B, 1=0, 2=UP, 3=DOWN
Station No	-66	11	1/98	9		
	67					
Set Card						
Originator Cruise No NODCINV			1/95	3		
Cast No	41	11	3+48	1	70	
Messenger Time	42	12	3+45	3	71	
Temp Prec	43	13	3+13	1	72	NOT PACKED IF ALL
Salt Prec	44	14	3+20	1	73	HAVE SAME PRECISION
S.V. Prec	45	15	3+32		74	
Cxy Prec	46	16	3+37		75	
Thermometric Flag TTY			3+7	1	USED TO BUILD 37	
Depth Quality Numeric Codes are:						
6 = Wires out depth values are not used						
7 = Flagged by NODC as doubtful					Values retained	
8 = Flagged by Originator as doubtful						
6 is subtracted from 7 or 8 giving a value of 1 or 2 which						
is multiplied by 2 and 1 is added if the depth is thermometrically determined						

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